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ABSTRACT

This paper lists the components of a curriculum theory, examines the constraints on theory building, and suggests several pcints at which the domain of curriculum research might be distinguished from learning and instruction. (Author/LLR)

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COMPONENTS AND CONSTRAINTS OF CURRICULUM RESEARCH*

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In curriculum, as in other departments of education, one would like to be sustained in belief and action by research. Presumably such research is being done, enough, at least, to warrant reviews at fairly regular intervals.* Moreover, one often hears the claim that "these materials were tested in the field" or that they were based on this or that research in learning. So presumably research is being used.

*See Review of Educational Research, 39:3, June 1969.

Nevertheless, one also hears the complaint that research can make little headway against the inertia of the educational bureaucracy and the ignorance of its functionaries. It is somewhat late in the game to do much about bureaucratic inertia, but of what research are the functionaries ignorant--and why?

Is it that the curriculum makers are unfamiliar with the variety of materials and schemes on the market? In this day of sophisticated merchandizing and vigorous educational entrepreneurship, can anyone avoid the sales pitches for the various curriculum goodies? And is it not the case that most of the long hours at curriculum conferences and committee meetings are devoted to reports of what is being done in this and that enlightened community?

Nor can the ignorance pertain to the "how" of making up a curriculum. The participatory machinery for "hammering out" objectives, assembling alternatives, reviews by committees, field tryouts, and evaluation is familiar enough to qualify as a ritual. And all of these procedural moves, if I am not mistaken, have themselves been subjected to variants of opinion research.

On the criteria of plenitude and variety, curriculum research must be judged successful. On a more rigorous criterion--the degree to which we are achieving a unified theory in terms of which generalizations can be accredited

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or discredited--progress in curriculum research has not been impressive, and perhaps not even discernible to the naked eye. Curriculum schemes are still regarded pretty much as matters of taste, not fit for disputing, and most curricula are cheerfully syncretic.

> Turning from the process to the content side of educational science, one is struck...with the paucity of ordered 'findings' from curriculum research--findings in the sense of either scientific conclusions from cumulative inquiry or of tested guidelines for curriculum decisions. There does not seem to be a sizable community of curriculum scholars who have staked out domains of inquiry with such clarity that successive studies are integrated into a larger whole, gaps identified, and new studies initiated.*

*John I. Goodlad, Review of Educational Research. 39:3, June 1969, p. 368.

Now it may be that we cannot aspire to unification among curriculum theories so long as the theories on which they depend are themselves so diverse. We may have to settle for a number of plausible theories, each based on its own conception of the relation between certain types of learnings and certain types of school outcomes. Yet to each of these theories the criteria of completeness, consistency, and coherence are relevant.

The search for more reliable generalization in matters of curriculum would, I believe, be more fruitful if these criteria were taken seriously, and if serious workers in the field felt obliged to apply them to each other's work. For if they cannot, then even within a given class of curriculum designs, it becomes virtually impossible to assess the cogency of claims; and unless we can in some way test each other's theoretical pretensions, then research studies accumulate without being cumulative. Educational research would be well advised to heed the injunction of Karl Popper--do everything you can to disconfirm hypotheses.

I shall try to clarify my own perplexities in this domain by setting forth the components of what might qualify as a complete theory of the curriculum; examine the constraints within which such theory building must operate, and finally, suggest several points at which curriculum research might distinguish its domain from those of learning and instruction.

Components of a Theory of the Curriculum

1.0 Hypotheses about objectives

- 1.1 Sources of generalizations
  - 1.11 Empirical evidence--common sense observation or formalized research
  - 1.12 Theoretical evidence from philosophy, ideology, etc.
- 1.2 Arguments supporting a given formulation of objectives

2.0 Hypotheses about relations between curriculum input and outcomes

- 2.1 Sources of generalizations
  - 2.11 Empirical evidence
  - 2.12 Theoretical evidence
- 2.2 Arguments or reasons for supporting a given formulation of this relation

3.0 Hypotheses about specific curricular inputs based on conclusions in 2 & 3

- 3.1 Types of input
  - 3.11 Subject matters from the disciplines
  - 3.12 Problematic situations
  - 3.13 Skill formation tasks
  - 3.14 Others
- 3.2 Arguments justifying choices, i.e., that they will meet criteria of 2 and 3

4.0 Hypotheses about rules for sequencing or packaging inputs

- 4.1 Sources for generalizations
  - 4.11 Empirical
  - 4.12 Theoretical
- 4.2 Arguments supporting the prescriptions for sequencing

It seems clear from an examination of this outline that curriculum theory borrows from other theories--theories about objectives, about teaching and learning, and about the relations between various school inputs to outcomes of various kinds. This dependence introduces several sorts of constraints.

Theoretical Constraints

The ideal curriculum theory would have the following form: School learnings A, B, C...and only A, B, C...will produce outcomes X, Y, Z...and only X, Y, Z.... Such a strict formulation is out of the question for domains far less muddled than education, so we should be happy to settle for a much more modest generalization, viz., school learnings A, B, C...produce outcomes X, Y, Z...with enough regularity so that we could say: "If we want outcomes X, Y, Z...we should promote learnings A, B, C."

Even this goal is beset with difficulties. One is the definition of outcomes. The results of school learnings can be formulated as (a) a more or less fixed response, (symbolic, attitudinal, or motor); (b) knowledge of a concept, a rule, a principle; (c) a method of using previous learnings over a wide range of situations; (d) cognitive and normative schema; (e) syndromes of attitudes; (f) character and personality structures; (g) general Weltanschauungen; (h) others according to taste.

I need only mention the chaos in communication that results when participants in educational colloquies do not stipulate in advance which of the meanings of outcomes listed above (or others I have not listed) they have in mind. Because such agreements are not stipulated, educational discussions often remind one of the traffic in a multilevel system of cloverleafs. There is much passing, but no meetings.

The broad range of meanings that can be attached to "outcomes" of school learning is matched by that of the learnings themselves; indeed, the examples given above of outcomes could equally well serve as examples of "learnings."

A learning can refer to anything from the learning of a new word to the knowledge attained at the end of a long and complex course of study. If we confront these two broad ranges of meaning, the hope of establishing one-to-one correspondence between items in the two domains is dim indeed.

For one thing we do not have the empirical knowledge that would enable us to isolate the variables which presumably produce a given school learning or the life outcomes of such learning. We do not know all that goes into the learning of 2 + 2 = 4, although we suspect that even here there are variables over which the school has little or no control. Our ignorance expands and our control shrinks as we try to understand such outcomes as good character, critical thinking, etc. This difficulty, however, does not seem to disturb the confidence of many of the curriculum makers.

Cultural Constraints

Objectives and means of achieving them, unfortunately, do not give guidance to the curriculum researcher until they descend (not condescend) to the cultural state of the world in which the pupil presumably will live. Thus self-realization, growth, critical thinking, or any other life outcome has to be translated into a conjecture that this and this content in this and this sequence has the best chance of producing the outcome under the conditions of 1980 or 2000 in America or on the moon. Curriculum research must either explore the probable shape of these cultural constraints itself or assess the research of other futurists.

Among the most important types of cultural variables are the technological maturity of the culture and the maturity of the arts and sciences. Together they determine the specific modes of cognition and feeling by which the individual will meet the needs of vocational competence, civic adequacy, and personal development. The curriculum theorist--on the evidence of research, one might hope--combines these factors into an hypothesis that certain school inputs will be used in nonschool situations so as to make things come out satisfactorily for the individual and his society in a particular form of the culture.

Let me indicate briefly how these constraints operate on curriculum theory and indirectly on the research task.

Technological maturity. Clearly, the ways in which we earn our living, discharge the duties of citizenship, and shape our personalities in a 20th century metropolis differ from these in Athens at the time of Socrates. Technological maturity determines the amount and kind of skill and knowledge that will be included in general education and the extent to which this general education will be made universal and mandatory. Above all, technological maturity controls the amount of time and money available for schooling. Since the level of education also determines technological maturity, we have here a circle of cause and effect that can be vicious or benign.

This intimate relationship between technological maturity and vocational or technical training is clear enough. That the relationship is equally close between technological maturity and general education is not so obvious, but it is there.

The most immediate influence of technological maturity is on vocational training, but there are two aspects of vocational education. One is specialized study and practice of a particular occupation such as farming, operating a lathe, or engineering. The other aspect is the understanding of the economic enterprise, the totality of activities that produce and distribute goods and services. Some of this understanding is a feeling for technology itself, i.e., for science-based skill. Some of it is a sophistication about finance, capital formation, modes of production, and the relations of production. To this aspect of vocational education general education makes a direct and perhaps terminal contribution. For genuinely self-sustained economic progress, this sophistication is probably crucial. A country can import machines and experts, but understanding in its citizenry it must produce itself.

The technological level of a culture also affects the schooling needed by the citizen. Technological complexity renders social problems complex, witness environmental degradation, poverty, legislative priorities, etc. The effect of such complexity is to make it virtually impossible for the citizen to understand social problems by the common sense matching of his own interests with legislative proposals. It is very difficult to achieve enlightened selfishness in such a society; enlightened unselfishness is even more demanding. A curriculum for citizenship has to go well beyond acquaintance with the machinery of government and spirited discussion of current events.

The technological maturity of the culture has decisive influence upon the sort of schooling needed for self-development, or what is sometimes referred to as personal development. In everyday language, self-development covers the knowledge, skills, and attitudes needed to remain sane, in one piece, and moderately happy. Traditionally, we relied upon the mores and social sanctions attending their violation to teach the young how to achieve self-development. For the children of the elite, the humanities were added in order to clothe the edicts of the mores in literary garb. The current return to the humanities may mean that one can no longer rely on the persuasiveness of the mores, or more accurately on their unity.

The humanities are still the value exemplars of man, but in and of themselves they are generic models of the good life. The specific behavioral shape of temperance, courage, justice, integrity is not given once and for all. Odysseus has his modern equivalent, but who is it? The Renaissance man cries out for a 20th-century embodiment; what artist will create his image for our time? The filling of the humanities-value-forms with new existential content requires the continuous exploration of value that unites the sciences and the humanities into a program of general education. Who is to be charged with this exploration and the translation of the discoveries into a course of study?

Like vocational competence and citizenship, self-development, to be effective, has to be widespread. In a mass society, only widespread general education can preserve some sort of granular structure in the evercoagulating lump.

Maturity of arts and sciences. The constraints imposed by the maturity of the arts and sciences, I take it, need no extended discussion. I shall mention only two of the problems they pose for curriculum theory. One is the reduction of the exploding profusion of knowledge to teachable form; the other is to find ways of developing the skills of interdisciplinary thinking.

The first task taxes both the ingenuity and erudition of the curriculum designer. Given limitations of time, how can the knowledge explosion be contained in any selection of courses and materials? How can one justify any schema that is finally prescribed? Much of the work done on the structure of knowledge and the taxonomies of the disciplines can be exploited for this purpose, but in the actual construction of the curriculum, consultation with discipline specialists is almost mandatory.

The second task is perhaps even more important than the first, and it bedevils mature interdisciplinary thinkers as well as students. It is tempting to resort to the dictum that we learn to do X by doing X, so that one can prescribe exercises in interdisciplinary thinking in the school as a way of learning to do interdisciplinary thinking in adult life. This presupposes that we know how to do such thinking, but anyone perusing any one of a dozen symposium volumes with interdisciplinary aspirations knows that these hopes are rarely fulfilled. We don't know how it is done.

Pedagogical constraints. /Finally, there is the whole range of pedagogical circumstances which constitute constraints on curriculum theory. Providing for individual differences in maturity, ability, and achievement is one; the resources of the teacher are another; the traditions of various schools and the idiosyncracies of parents and board members still another. For however we may differ in the defining of curriculum, we must agree that it involves packaging some sort of content for instruction.

To manage these components and constraints, curriculum theory needs a vantage point or pivot that is located somewhere between the end of instruction (the end of a course or the end of a year or a grade) and the broad life outcomes expressed in terms of vocational success, adequate citizenship, the happy life, or the playing of roles in the various social institutions. Perhaps this pivotal point could be represented by such process outcomes as learning how to learn, ability to do critical thinking, problem solving. If I am hesitant about this type of formulation, it is because every such process operates with content, and the transfer of the process to content other than that practiced in school remains an assumption that is not as yet clearly warranted. End of instruction outcomes leave open the question as to whether they will lead to the life consequences that are the ultimate rationale of schooling, yet broad life outcomes are the function of so many nonschool factors that it is difficult to pinpoint the school inputs that are relevant to them.

It seems to me, therefore, that the overarching regulative constraint on curriculum theory is the way schooling is used in nonschool tasks that <u>everyone is called upon to perform throughout life</u>. These tasks cannot be those that have to do with highly specialized skills. They are the tasks encountered in the discharge of our duties as citizens and in the development of the person. Furthermore, they must be tasks in which there is little doubt that school inputs do function. As a preliminary approximation, we might think of such tasks as reading newspapers, magazines, books; discussing social and personal problems; expressing evaluations of materials read and discussed.

This sort of task is too gross for the learning researcher and to microscopic for the educational philosopher; if the curriculum researcher does not take an interest in this, probably nobody else will.

However, choosing the sample or test tasks is not the most important move in the research strategy. More important is to find out how school learnings function

in such tasks. Do they function by melding into an apperceptive mass by which a stimulus is ingested into a context of experience with a structure of its own? Do they function by structuring the stimulus situation in a peculiar way? Above all, what transformation, if any, in the school input takes place as they are used? Or does a transformation in the input take place before they are used?

The significance of these questions lies in the doubts they may raise about the operational assumption of most learning research, vis., that the school input is used by being reinstated on appropriate cues, pretty much as learned. Thus given the cue 7 + 6 = ?, the pupil selectively reinstates his learning of the number facts. Similarly, when answering the questions: When did Columbus discover America? How far is it from the sun to the earth? What was the cause of the Civil War? It was this assumption that lay behind the job analysis approach to the curriculum, viz., analyzing various tasks in terms of the knowledge and skills they entailed. Having found them, they and they alone were to be taught--for future replication. Thus, only vocabulary used in actual letter writing by a representative sample of the population was to be taught; only words commonly misspelled were to be practiced; only the kind of arithmetic problems encountered on the farm were to be taught in rural schools.

The Committee on the Economy of Time in Education appointed in 1911 by the NEA operated on "the fundamental assumption that it is uneconomical to teach a child something he does not need to know, and that economy will result from the selection of only that knowledge which is directly serviceable."*

*Geraldine M. Joncich, ed., Psychology and the Science of Education, Selected Writings of Edward L. Thorndike, New York: Teachers College, Columbia University, 1962, pp. 16-17.

Uses of Schooling or School Learnings

These doubts make it necessary to pose more directly the question: How are school learnings used? Is there just one type of use, or are there many different types? What constraints do they impose on curriculum theory and research?

I have elsewhere dealt with four types of use in some detail.* Here it will

*Broudy, B. O. Smith and J. R. Burnett, Democracy and Excellence in American Secondary Education, Chicago: Rand McNally, 1964.

be sufficient to sketch them briefly, because my primary concern is not to add another taxonomy to the literature, but rather to draw attention to the possibility that in at least one very important use of schooling there is not, need not, and perhaps cannot be an equivalence between school input and life output. The replicative use of schooling, or what we may call rote recall, needs no further comment. The other familiar one is the applicative or applicational use in which a principle or a fact or both learned in school are used to solve a problem, e.g., using the knowledge of chemistry to remove stains from tablecloths or to design a rustproof watering can or to improve nutrition. The associative uses and interpretive uses will be discussed shortly.

First, however, it may be appropriate to note that learning theories tend to concentrate on the type of mental functioning that happens to enjoy a high premium at a given time. When writing was important, as it was for the Egyptian scribes, skill learning had to be explained. Learning long passages of the Koran or reams of Chinese classics by heart was considered as a model of learning when success fell to those who could do it well. In the schools of chivalry, attitude formation toward warriors and women /was the problem of pedagogy. Today, of course, the paradigm of learning is furnished by the way scientists devise and use scientific concepts in technology. In every period, therefore, lurks the danger that learning theory is shaped by one type, and that the schools will overstress the fashionable type of learning to the neglect of others.

This myopia may lead to several undesirable consequences. One is that we forget that/high-level cognitive function even involves some replicative and associatives uses of learning, and thus the easy dismissal of the learning of facts can be mischievous. One cannot learn engineering simply by studying logic

and physics. Another is that the applicational use so distinctive of technology is not to be equated with solving problems at the end of the chapter in the textbook, or going through the predicament-hypothesis-decision routine. Application entails a great familiarity with the phenomena of a given domain, together with a technology for translating theory into operational equivalents. Most of us, outside of our field of specialization, don't do much applying of knowledge. Most of what we call application outside of our specialty is inference by similarity or suggestive analogy, i.e., it is a form of interpretation rather than application. For this reason, phrasing educational objectives in terms of using school learnings for application to life is likely to be misleading.

Between the replicative use of schooling--which cannot and need not be wholly avoided--and the applicative use, which is demonstrated only in the domains of our expertise, are at least two others. One is the <u>associative</u> which wreaths a stimulus with garlands of meanings and images. Think, if you please, of the <u>image</u> (not the definition) aroused in your mind by the words "transport" or "transpire." In many years of questioning students, I have found that those innocent of Latin never had an image of "carry across" or "breathe across" in connection with these words.

I doubt that many of those whose imagery is Latinized would care to take a formal examination in Latin rhetoric, and they probably would say they never made any use of their Latin study. They are using Latin study associatively, not replicatively. We have here, incidentally, an example of nonserendipity in research. The experiments on transfer that rendered the <u>coup de grace</u> to the study of Latin because they could not demonstrate its value for improving English vocabulary obscured a much more important use of Latin, viz., providing imagery indispensable for responding properly to English literature in general and poetry in particular. Because the associative use of schooling is not simple replication,

it is difficult to measure, and since what does not show up on replication tests it seems a folly to teach, the "apperceptive mass" needed for all appreciative experience is not regarded as a worthwhile school objective. Yet we persist in teaching classical English poetry.

Unlike the associative response, the interpretive use instantiates a set of categories. These categories may be primarily intellectual and in educated minds are taken from the sciences, or they may be moral and aesthetic derived from philosophy, religion, and the arts. Both types of schemata not only classify phenomena, but also provide norms for discourse and thought in the relevant domains. Interpretation is also called understanding; when school learnings are used interpretively, they are used to think and feel <u>with</u>.

The importance of interpretive use of knowledge is beyond question. For example, writing about "The Crisis of Crises," W. D. McElroy, Director of the National Science Foundation, said:

> We know little about the more subtle effects of pollution. We cannot predict with confidence the behavior of individuals nor that of social groups and institutions. We are not in a position to assess adequately the relative costs and benefits to society of any technology or any course of action. The special crisis that confronts us, as scientists, and that confronts our political leaders, who need and who must support our efforts, is thus one of perspective.*

*Editorial, <u>Science</u>, 1967:4, January 2, 1970.

Perspective building is another name for the interpretive use of knowledge; so is context building.

I think it is fair to say that in the tasks mentioned as typical of the thought of the citizen, the use of schooling is predominantly interpretive and, as a consequence, the primary use of general education is interpretive with strong assists from the associative.

The Paradox

But at this point we are confronted with a paradox. Although the school input we call general education is supposed to issue in interpretive uses, it is difficult to put one's finger on the part of the school input that functions during the interpretation. For if we give an end-of-course test in virtually any high school or college subject to someone who has been out of college for a few years, we find that he does poorly on items that require rote recall of facts, specific names, dates, rules. Principles, we are told, are remembered longer, but the precise formulation decays into recognition. Physicians in practice could not pass high school examinations in chemistry and perhaps not even in biology, and some successful lawyers might not do well on examinations in constitutional history. In one nationwide test on American history in the forties, the American public "failed" so dismally that another hue and cry to teach more history was raised. We use Latin imagery, although we can no longer decline Latin verbs or translate a line in Virgil.

So we have the awkward situation that if a curriculum is to be justified in terms of the amounts of school input that can be replicated later in life, very little of what we call general education can be justified at all. For this reason, general education requirements are resisted by all specialists and would-be specialists. Why, then, not get rid of this type of schooling? Some educators have argued for doing just this, but that they have not been taken too seriously must be explained by the fact that on the reading, discussing, thinking tasks enumerated above, those who have had formal schooling do perform differently from those who have not had it. The physician can read and discuss materials involving chemical concepts that the chap who has never studied chemistry cannot; the difference, we may say, shows up in the categorial frameworks, perspectives, and contexts needed for interpretation, and very often we are not consciously aware of these schemata as we are using them.

Just as without the cues from eye and brain we cannot see, so without cues gained in the formal studies we do not interpret experience as do physicists, economists, historians, and poets. But just as we are not attending to our eyes and brains in seeing, so we do not attend to the lessons studied in this or that course while using them for interpretation.

In Michael Polanyi's terminology, this is tacit, subsidiary knowing rather than explicit, focal knowing. According to him, two kinds of knowing enter "jointly into any act of knowing a comprehensive entity." There is knowing a thing by attending to it in the way we attend to an entity as a whole, and knowing a thing by relying on it for purposes of attending to an entity to which it contributes. This latter knowledge he calls "tacit." As one example of tacit knowing Polanyi cites the viewing through a stereopticon of two pictures of an object taken from slightly different positions. We see one image, however, and this is at the focus of attention; of the separate images we are aware--if we are aware of them at all--only as "guides to the image on which we focus our attention." But we cannot see both one and two pictures simultaneously.*

*"Logic and Psychology," American Psychologist, 23:1, pp. 27-43, January 1968. Also The Tacit Dimension, The Terry Lecture, Yale, 1962. New York: Doubleday, 1966.

It is to be noted that the resultant image is not merely the sum of the two separate two-dimensional pictures. It is an emergent characterized by apparent solidity in three-dimensional space of which the two "inputs" were the necessary but not sufficient conditions. Analogously, we may hypothesize that life uses of schooling are guided by emergents (goals, value syndromes, categories) that may not have been included as such among the school inputs, albeit the latter may have been necessary for the emergent to emerge.

Gestalt psychology, of course, makes phenomena of this sort--especially that of figure-ground, closure, whole-qualities--central to its theory, but I am

not here arguing for the theory as such or for Polanyi's views as such. But the facts alluded to are to be accounted for, and they do not seem to be accounted for by the model of inputs retrieved on specific signals or even slightly generalized ones. For the very idea of generalization goes beyond the particular items generalized and poses in another form the very problem we have been considering. Can we think of generalization as an instance of using the particulars as cues that conjointly contribute their meaning to a more comprehensive entity?

The theoretical significance of tacit knowing for curriculum theory is that if it can be given some empirical plausibility, it helps to dissolve the paradox alluded to. But also if this notion, or some analogous one, is taken seriously, then the criteria of learning will have to be viewed differently. The slogan "Down with nonbehavioral objectives" may not be so decisive for educational testing or research or curriculum prescription, although it should be abandoned only as a last resort and probably never abandoned when we are trying to measure end-of-instruction outcomes. The difficulty, of course, is to counter the objection that tacit knowing is an appeal to ignorance, mysticism, and obscurantism, and those who like Polanyi rely on this concept must give evidence to meet this objection. I happen to believe that his arguments are persuasive enough to warrant the research into the uses of schooling sketched out above.

If I am right, research into the uses of schooling in general, but in the associative and interpretive uses especially, could give the curriculum theorist a more realistic and more fruitful guide than those he is now accustomed to using. But if the school inputs are not unambiguously traceable in the life outputs, how can we research these relationships?

As regards the associative use of schooling, we might try to analyze failures in response owing to failures in imagery or to meagerness of connotation. Teachers

of English literature have to do this sort of diagnosis every day and although one might not find it worth doing, there is no reason in principle why the major works in literature and the other arts could not be plotted in terms of symbolic and imagic demands they make on the reader or viewer or listener. The numerous studies on symbolism in the arts could be utilized in such research. Does the study of poetry in school provide such reservoirs of images? Does study in the related arts do better in this regard? What about the influence of television and motion pictures?

Similarly with the interpretive use. First might come attempts to diagnose interpretive failures with standardized materials. This might lead to studying the pupil's context-building habits and resources. By the construction of diverse sets of such reading and explicating tasks with diverse appropriate samples, one could apply the techniques of research with which we are so familiar, viz., finding measures of correlation and variance among all sorts of variables. However, this is probably a stage of research for which we are not yet ready. It may be that we must first study the tacit functioning of school learnings phenomenologically and naturalistically in order to reveal variables that are really relevant. For some time, one might expect, fruitful hypotheses will emerge from intuitive hunches rather than from systematic inductions from systematically gathered data. From such hypotheses, or rather suggestions for hypotheses, may come theoretical constructs that will enable us to understand better how various school inputs become frameworks for a wide variety of cognitive and evaluative interpretations. The work already done in semantics, linguistics, the logic of discourse, and on the dynamics of imagery provide promising beginnings for such study.

I shall conclude this foray into possibility by anticipating the objection that if we succeeded in discovering just what input of a biology or chemistry or literature course does function later in life, this could be taught as it is used.

Is this not, therefore, just another way of finding an input that can be replicated as an output? The objection would be more cogent if we could assume that in order to get the desired output, we need only make it an input. This is a bit like saying, "If you want the body to put out muscular energy, equip it with a motor, not food." However, if, as one might suspect, the input is transformed in becoming an effective schema for association and interpretation, then the objection loses much of its force. This transformation takes us into learning theory and research, and I can only think that here too simple S-R connectionism has not proved apt in accounting for the processes that apparently are instated when knowledge is used interpretively or associatively. This may be a fruitful link between research into school learning and curriculum.